

The mean free-air temperatures for Royal Center for the first half of the year were slightly above the normals for the same period; those for Broken Arrow and Groesbeck for the first five and four months, respectively, were moderately below normal.

In Table 2 it will be noted that the highest average maximum altitude reached by airplane was 6,242 meters above sea level at Omaha and the highest single flight to 7,242 meters was also made at this station. An airplane

flight was made on every day during the latter half of the year at Dallas; only one day was missed at Cleveland and this was due to mechanical trouble with the airplane; two days were missed at Chicago, and nine days at Omaha on account of unfavorable flying weather.

There were 14 new pilot balloon stations established and 2 closed during 1931, making a total of 69 such stations in operation at the end of the year. Of these, 3 are located in Alaska and 1 in Porto Rico.

TABLE 2.—Observations by means of airplanes, kites, captive and limited-height sounding balloons during the year 1931

	Broken Arrow, Okla. ¹	Chicago, Ill. ²	Cleveland, Ohio ²	Dallas, Tex. ²	Due West, S. C. ¹	Ellendale, N. Dak. ¹	Groes- beck, Tex. ¹	Omaha, Nebr. ²	Royal Center, Ind. ¹
Mean altitudes (meters), m. s. l., reached during month	2,861	4,861	5,586	5,526	2,679	3,254	2,334	6,242	3,219
Maximum altitude, (meters), m. s. l., reached	³ 5,906	5,692	6,355	6,304	³ 5,477	³ 6,324	4,702	7,242	³ 9,445
Number of flights made	165	182	183	184	362	355	99	139	182
Number of days on which flights were made	⁴ 151	⁴ 182	⁴ 183	⁴ 184	346	338	⁶ 99	⁷ 137	⁸ 173

¹ Kites, captive or limited-height sounding balloons.

² Airplanes.

³ Limited-height sounding balloon.

⁴ January 1 to June 7, inclusive.

⁵ July 1 to December 31, inclusive.

⁶ January 1 to May 16, inclusive.

⁷ August 8 to December 31, inclusive.

⁸ January 1 to June 30, inclusive.

WEATHER IN THE UNITED STATES

[Climatological Division, OLIVER L. FASSIG, in charge]

THE WEATHER ELEMENTS

By M. C. BENNETT

GENERAL SUMMARY

The continuation of abnormally warm weather during December in practically all sections east of the Rocky Mountains, and generous widespread precipitation in the interior and Southern States, were the outstanding features. The temperature for the month ranged generally from 4° to 12° above normal east of the Great Plains, except that in the extreme Northeast it was not so warm. The greatest plus departures for the month extended from Kentucky, Missouri, and eastern Kansas northward. West of the Rocky Mountains, temperatures were unusually low in many places, while in the Pacific coast sections they were only slightly below the normal. The precipitation was above the average in most areas, though along much of the Atlantic coast, in the Rocky Mountain region, and eastward therefrom along the Canadian border to the Great Lakes it was generally below the normal. Between the Appalachian and Rocky Mountains, except in eastern Oklahoma and portions of the adjacent States, the amounts were unusually generous, with many sections having from one and one-half to four times the normal. It was heavy in California also, where some stations reported nearly two and one-half times the average. In the western mountains snowfall was unusually heavy, while in the East but little snow fell.

TEMPERATURE

The first half of December continued the temperature features of the latter part of November, the eastern half of the country having mild weather, as a rule, and the western half severe cold. The temperature at this time was particularly low, compared with normal, in the Plateau and Rocky Mountain regions, and the first week saw comparatively cold weather in Texas and Louisiana as well; while some portions of the Missouri Valley, the Lake region, and the extreme Northeast likewise were moderately colder than normal about the 4th to 7th.

After the middle of the month the western half of the country was usually warmer than normal, especially the Plains and Rocky Mountain regions and those far west-

ern districts which are close to the Canadian boundary. Exceptions were to be found in the middle and southern Plateau region, and in the lower half of the Rio Grande Valley where abnormal cold continued till about the 20th. This half of December was extraordinarily warm for the time of the year in the north-central portion of the country, and was far warmer than normal elsewhere east of the Plains, except in the extreme northeastern portion where it was only moderately warmer.

As a whole, December was warmer than normal in very nearly the same part of the country that November had been; that is, east of the Rocky Mountains. However, the northern portions of Washington and Idaho, almost all of Montana, and the eastern portions of Wyoming and Colorado changed from colder than normal in November to slightly warmer in December, while the middle Rio Grande Valley made the reverse change.

Parts of New York and New England averaged but slightly warmer than normal in December, but otherwise all the country from the eastern Plains region and the lower Mississippi Valley eastward was far warmer than normal. In much of Wisconsin and States adjoining, also in portions of the extreme Southeast the mean temperature was 9° to 12° above normal.

In north-central and southeastern districts the month was usually the warmest December during the last 40 years, but was not so warm as December, 1889, save in a few localities.

The highest temperatures were close to 90° in a few of the southernmost States, and not far from 60° in northern border States and in the middle Plateau region. They occurred largely about the 11th to eastward of the Mississippi River, but at various dates between the 17th and the end of the month in practically every State west of that river.

The lowest readings were much below zero in the mountainous portions of the far West, also in the Dakotas, New York, and New England. As far north as Iowa, Ohio, and the mountains of Maryland zero temperatures were not experienced, while in Florida the lowest reading was 36°. The lowest temperatures occurred usually during the first half of the month, except in some of the Atlantic States, where they occurred during the final week.

PRECIPITATION

The first fortnight brought heavy rainfall to most portions of the Gulf and South Atlantic States, and the second week saw much precipitation also in the Ohio Valley, New England, and the greater part of the far Southwest.

The third week of the month was a notable period for precipitation in the extreme Northwest, while from Alabama and northern Georgia westward to eastern Texas heavy rainfall continued. The latter part of the month saw much precipitation in the far West, especially in California; while the middle Gulf region, the Carolinas, New England, and the Missouri and lower Ohio Valleys had considerable amounts.

As a whole, December was a month of liberal precipitation, and the distribution over the country was comparatively good. In the Gulf States, the lower Mississippi Valley, and the interior of the South Atlantic States there was considerably more than normal. The immediate South Atlantic coast had usually less than normal, though sufficient, as a rule, to considerably relieve the intense dryness developed by the fall months. In Tennessee, Mississippi, Louisiana, and eastern Arkansas the heavy December rainfall was detrimental, because of large falls in the months preceding.

From North Dakota to Michigan there was scanty precipitation in the northern portions of the respective States, but about normal or somewhat more than normal in the southern portions. The middle and lower Missouri Valley generally had far more precipitation than normal. At St. Joseph, Mo., this was the wettest December of the past 20 years. The Ohio Valley and the upper Mississippi Valley from northeastern Iowa southward had usually somewhat more precipitation than normal, and the same was true of considerable portions of the lower Lake region and of northern and eastern New England. Central Kansas, western Texas, and eastern New Mexico generally received greater than average amounts. The Pacific coast region and the western half of the Plateau

region had far more than normal, particularly central and southern California.

Deficiencies were noted in central and northeastern Florida, in the middle Atlantic area and southwestern New England, from central Oklahoma to southwestern Missouri, in most of Montana and of western Nebraska, and nearly everywhere near the Rocky Mountain Divide.

SNOWFALL

The features of December snowfall greatly resembled those of November. In the eastern half of the country there was not very much near the Canadian boundary, and farther south none of consequence in the majority of districts where snow is anticipated. Near the Ohio River, along Lake Erie, and from eastern Pennsylvania to southern New England several stations reported no measurable snowfall, and most others found the December total the least of record.

In the middle and northern Plains there was moderate snowfall but usually less than normal except in South Dakota.

In the far West the snowfall at elevated stations was generally much greater than normal, several stations finding it the snowiest December for 10 years or longer. The supply remaining at the end of December in areas where storage toward the stream flow of next summer is important was very satisfactory in most of the States which lie west of the Continental Divide, and in considerable portions of New Mexico and Colorado also.

SUNSHINE AND RELATIVE HUMIDITY

More than the usual amount of sunshine for December prevailed generally in the Southeast, while in the far Southwest less than the average was received. Elsewhere about the normal amount prevailed. The relative humidity was generally above normal except in much of the Northeast, portions of the northern Rocky Mountain region, and the northern Pacific Coast States. However, almost everywhere the departures from the normal were small.

SEVERE LOCAL STORMS, DECEMBER, 1931

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path (yards)	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Shelby County, Tenn.	6-13				\$100,000	Rain and flood	Chief damage to roads	Official, U.S. Weather Bureau.
Block Island, R. I.	7	2:50-3:20 p. m.		3		Wind squall	Sloop and crew lost; steamboat disabled	Do.
South Carolina (western)	8-9					Glaze	Wires and trees broken; communication services impaired considerably	Do.
Mississippi (delta counties)	8-24					Rain and floods	60,000 acres affected	Do.
Texarkana (near), Tex.	11	2 a. m.	200	2	10,000	Tornado	Several buildings damaged or destroyed; 9 persons injured	Do.
Hortman (near), La.	13	1:35 a. m.	50-500	2	8,700	do.	Buildings, crops, and timber damaged; path 3 miles long	Do.
Columbia and Ouachita Counties, Ark.	13	A. m.		1		Tornado and downpour	Scores of buildings wrecked, chiefly at Waldo, Stephens, and Camden; bridges and embankments washed out; 15 injured	Post (Washington, D. C.).
Owings Mills and Rockville, Md.	14	P. m.		2		Wind	Trees and poles blown down; minor damage to other property	Official, U.S. Weather Bureau.
Eureka, Calif., and vicinity	17					do.	Considerable damage to telephone, telegraph, power lines, and buildings	Do.
Simpson County, Miss.	30	P. m.		5	50,000	Probably tornado	50 persons injured; character of damage not reported	Do.
Auburn (near), Ala.	30-31					Wind	Several buildings destroyed; trees uprooted	Do.
Roberson Springs (near), Ala.	30-31			4	4,000	Tornado	Several homes demolished; path 10 miles long	Do.
Montgomery, Ala.	31	2-4 a. m.				Wind	Large windows broken; many telephones put out of order	Do.
Gadsden and adjacent counties, Fla.	31				10,000	Winds	Several large tobacco barns razed; buildings unroofed; slats, telephone, telegraph wires, and pine timber damaged; fruit blown off	Do.
Boone County, Iowa	31					Glaze	750 telephone and telegraph poles blown down; trees broken; highways hazardous	Do.